SOYBEANS

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SOYBEANS

The soybean gives every indication of becoming a valuable addition to the field crops of Canada. Its possibilities are being actively investigated in almost every province of the Dominion, although production is so far limited almost entirely to the Province of Ontario. The total acreage for the Dominion in 1933 is estimated at 15,000 acres. Since the total acreage in 1929 was probably less than 1,000 acres the increasing interest in the soybean as a field crop is fully evident.

Present production of the soybean in Canada is chiefly for seed, which, being extremely rich in protein and oil has a high commercial value. The industrial uses for which it can be utilized are numerous. The seed also has considerable value on the farm for live stock feeding and, since the soybean plant itself possesses a high nutritive value for fodder, it is quite possible that as production increases the crop may find its greatest use on the farm, rather than in industry.

The Dominion Department of Agriculture during the past ten years has introduced and tested hundreds of varieties and strains of soybeans from various parts of the world. Through selection and breeding it is hoped to obtain new varieties better suited to the various conditions throughout the country. While soybeans have a much more limited adaptation in Canada than in the United States, where approximately 4,000,000 acres are being grown, the development of better adapted varieties will constantly enlarge the area throughout the Dominion in which this crop can be successfully produced.

Since the soybean is comparatively new as a farm crop in Canada this pamphlet is intended to give information as to the characteristics of the soybean plant and seed; its adaptation to soil and climatic conditions; the various purposes for which soybeans are used; the most suitable varieties that are available; and general instructions on how the crop should be grown and handled.

Description of the Soybean Plant

The soybean is an annual plant belonging to the family Leguminosæ. It has an erect, bushy, habit of growth and varies in height from one to five feet according to variety and season. The stems, leaves, and pods are covered with fine, short hairs. In some varieties growth at the tips is so slender that there is a tendency towards vining for support. Branching, which occurs at the lower nodes, varies in amount in different varieties and seasons and under different conditions of growth. The type of branching may be described as erect, mid-erect, spreading, or spreading widely. In the latter types especially, there is a tendency for splitting to occur at the point of attachment of the lower branches to the main stem, causing them to lodge on the ground. This, to some extent at least, appears to be a varietal characteristic, although unfavourable weather during a season of heavy growth may bring about this condition in almost any variety.

The soybean is normally self-fertilized. Natural crossing occurs to a limited extent but conclusions reached by numerous workers places the amount at considerably less than one per cent. The flowers, which are small and usually either white or purple in colour are borne in axillary clusters. The flowering period of a single plant is comparatively short, hence all of the pods develop and mature at approximately the same time. The pods bear from

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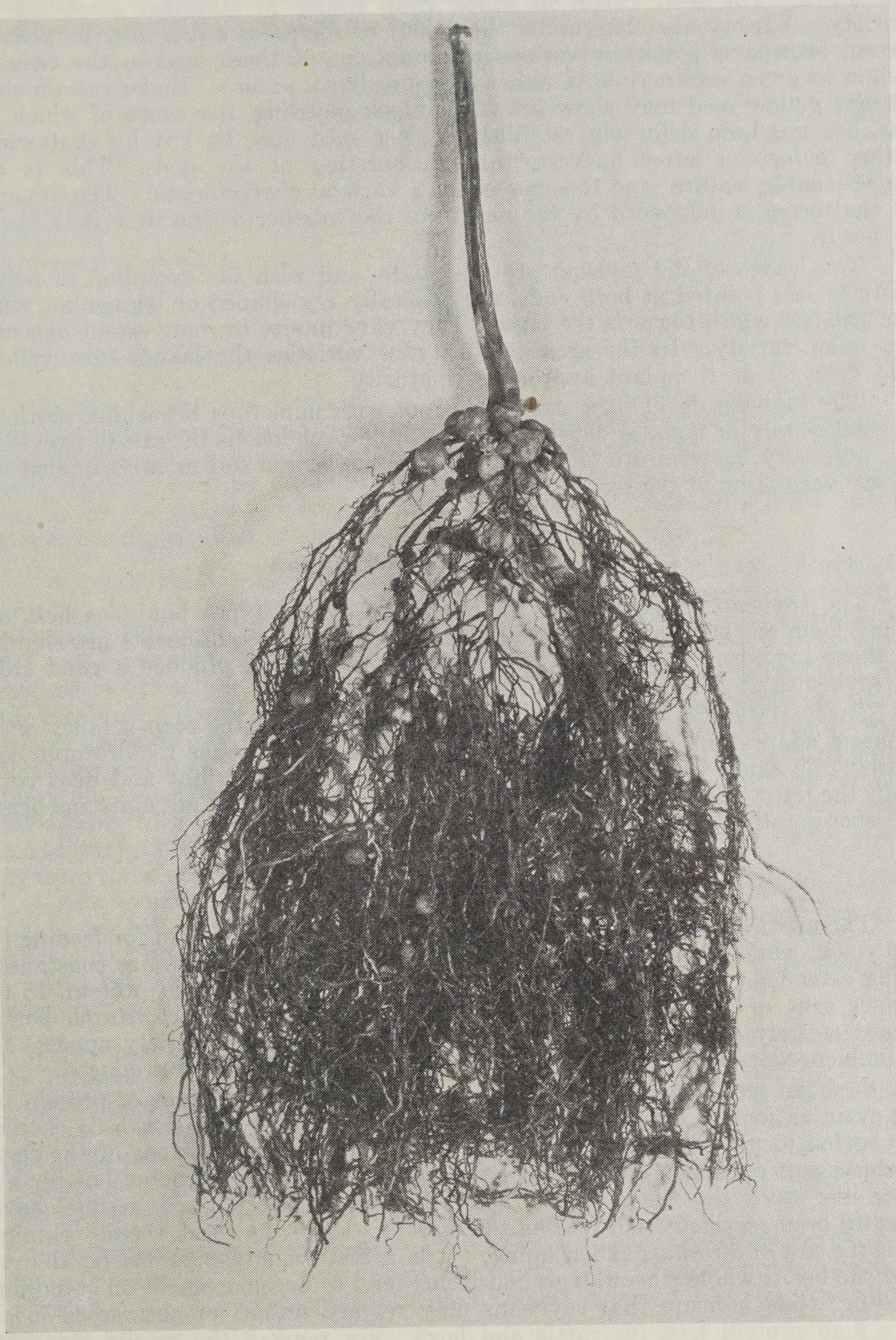
A mature soybean plant of good type.



Root of a soybean plant, showing development of nodules.

one to four seeds and their size depends upon the number and size of the seeds contained. The seed varies in shape from round to elliptical according to variety. Variety also determines the colour of the seed, which may be yellow, green, brown, or black, or various combinations of these, and in the case of yellow or green seed may have either brown or black hilums. Under certain conditions yellow seed may show brown or black mottling, the cause of which so far, has not been definitely established. The seed may be lost by shattering, either before or after harvest, through bursting of the pods. This is an objectionable feature and to some extent a varietal characteristic. The amount of shattering is influenced by the nature of the weather at the time it is likely to occur.

The leaves of the soybean are tri-foliate, and with the exception of being more or less pointed at both ends, are generally egg-shaped or triangular, with the greatest width towards the base. They vary in size to some extent depending upon variety. In the great majority of varieties the leaves turn yellow and drop off as the plant approaches maturity.

The soybean develops a strong tap-root with numerous branching rootlets. A good supply of nodules develop under suitable conditions of growth provided the necessary bacteria are either already present in the soil or are supplied by direct inoculation of the seed.

Soil and Climatic Adaptation

The soybean is adapted to a wide range of soil types but does best on sandy loam or clay loam. Generally speaking the soil requirements are similar to those for corn. A soil too acid for clover will often produce a good crop of soybeans.

The variation in maturity of soybean varieties gives the crop a fairly wide climatic adaptation. In general, the early maturing varieties require approximately the same seasonal conditions as early varieties of flint and dent corn while the late varieties are adapted to conditions in which the late flints and dents are successfully produced.

Uses of Soybean Seed

The mature seed of the soybean plant is valuable on the farm for feeding to live stock, while commercially it has a multiplicity of uses which are constantly being extended. It contains on the average 35 to 40 per cent of protein, 15 to 20 per cent of oil and 25 to 30 per cent nitrogen-free extract, starch being almost entirely absent. Composition of the seed of any one variety appears to be influenced considerably by the environment in which it is produced.

Soybean seed is a protein concentrate. It is a valuble source of protein in the grain rations of dairy cattle, beef cattle, sheep and brood sows. It should not be fed to market hogs in any quantity, as the high oil content of the seed produces soft carcasses. For dairy cattle the seed should be ground, but for all other live stock the whole beans are satisfactory. Very good results have recently been reported from feeding the mature seed in the sheaf, thereby eliminating the cost of threshing and grinding. It is a distinct advantage to be able to feed the beans whole since the ground beans tend to become rancid on standing. Feeding trials indicate that soybeans may replace linseed or cottonseed meal as a high protein feed for cattle and hogs. For poultry the results obtained from feeding ground soybeans appears conflicting. Both soybean seed and soybean meal need to be supplemented with a suitable mineral mixture when fed to either poultry or hogs. Owing to the difficulty of grinding soybeans alone, due to the high oil content, the seed should first be mixed with corn, oats or barley.

The following table[1] gives the digestible nutrients in 100 pounds of soybean seed and meal and other high protein concentrates, with their nutritive ratios, (barley and oats are included for comparison).

Feed	Crude protein	Carbo-hydrates	Fat	Total	Nutritive ratio
	lb.	lb.	lb.	lb.	
Soybean seed	32·2	24·7	16·1	94·1	1 : 1·8
Soybean meal	39·7	34·7	4·5	84·5	1 : 1·1
Linseed meal	30·2	32·6	6·7	77·9	1 : 1·6
Cottonseed meal (prime)	33·4	24·3	7·9	75·5	1 : 1·3
Barley	9·0	66·8	1·6	79·4	1 : 3·6
Oats	9·7	52·1	3·8	70·4	1 : 3·8

[1] From "Soybeans in Minnesota", University of Minnesota, Special Bulletin 134, 1930.

In the Orient the soybean is used very extensively for human food. Although the mature seed may be prepared similar to navy or field beans, generally speaking they are rather more difficult to cook. When the beans have reached the fully developed stage they may be used as a green vegetable similar to the green pea or lima bean. Boiling the pods for several minutes facilitates the shelling of the beans.

Soybean Meal.—Soybean meal or cake is a by-product of the oil extraction process. It is the residue after the oil has been extracted from the beans at the oil mill. The meal produced in Canada and the United States contains from 4·5 to 8·5 per cent of oil, depending upon the method of extraction. The solvent method of extraction (used principally in Europe) may reduce the oil content of the meal to 1 per cent or less. Removal of the oil raises the percentage of protein, which accounts for the fact that soybean meal has a higher protein content than the seed itself. Being rich in protein, soybean meal can be used to balance the grain rations of all classes of live stock. In feeding trials it has compared favourably with other high protein concentrates, such as linseed meal and cottonseed meal. Like the seed, it is deficient in minerals and requires a simple mineral mixture to be added when fed to poultry or hogs.

As a source of nitrogen in a fertilizer mixture for tobacco, soybean meal was found to be equal if not superior to cottonseed meal in a recent test at the Dominion Experimental Station, Harrow, Ont.

Soybean meal is being used also in the manufacture of flour, vegetable casein, glue, sauces, celluloid substitutes and other products.

Soybean Oil.—Soybean oil is extracted from the seed at the oil mills either by pressure or by the use of solvents. It is a drying oil inferior in drying qualities to linseed oil but superior in this respect to the semi-drying cottonseed oil. It may be substituted for linseed oil in certain kinds of paint, to the extent of about 25 per cent. It is also used in the manufacture of soft soap, varnishes, waterproof goods, salad and cooking oils, lard and butter substitutes, and various other products.

Soybean Flour.—Soybean flour is made from either the whole beans or from soybean meal or cake. Flour from the whole bean tends to become rancid on standing due to the high content of oil, although it is now claimed that a special process has overcome this objection. Soybean flour is being used successfully in the making of bread, biscuits, muffins, pastry, etc., and on account of its composition increases the nutritive value of these products. It is used in the proportion of one part soybean flour to three parts wheat flour. On account of its extremely low starch content it is especially valuable for diabetic persons.

Uses of the Soybean for Forage and Soil Improvement

The soybean may be grown as an annual hay or as a pasture crop; it may ensiled or fed green; or it may be ploughed down to improve the fertility of the soil.

The soybean is one of the few annual legumes suitable for the production of hay and can therefore substitute for this purpose in the event of clover or alfalfa failure. In three to four months after seeding it produces hay equal in quality to alfalfa hay, suitable for feeding to all classes of live stock, including poultry. Possessing a high content of digestible protein, it can be used to reduce the amount of costly concentrate feeds. It is usually recommended to feed it along with other kinds of hay as it is claimed that there is a possibility of digestive trouble from feeding soybean hay alone. Seeding at the proper rate and harvesting at the right time will result in the production of good quality hay with fine stems and will largely overcome wastage which sometimes occurs in feeding soybean hay with a high percentage of coarse stems.

ANALYSIS OF SOYBEAN HAY IN COMPARISON WITH OTHER IMPORTANT HAY CROPS[1]

Kind of hay	Moisture	Ash	Crude protein	Carbohydrates		Fat	Digestible protein	Digestible carbohydrate equivalent[2]
				Crude fiber	Nitrogen-free extract			
Soybean	8·4	8·9	15·8	24·3	38·8	3·8	11·2	44·0
Alfalfa	8·3	8·9	16·0	27·1	37·1	2·6	11·5	42·0
Red clover	12·9	6·9	13·6	24·1	39·1	3·4	8·3	43·2
Timothy	12·5	5·4	6·8	28·3	44·3	2·7	3·3	44·7

[1]From "Soybean Utilization", by W. J. Morse, Farmers Bulletin No. 1617, U.S.D.A. 1932.
[2]The carbohydrate equivalent shown is the sum of the digestible crude fibre and nitrogen-free extract, plus 2·25 times the digestible fat.

Soybean straw obtained from threshing has a definite feed value and can be fed to all classes of livestock. When used in addition to concentrated feeds it has given better results than corn stover.

The soybean provides satisfactory pasture for livestock of all kinds, although several other annual crops might be used to better advantage for this purpose. When bad weather or other conditions interfere with harvesting the seed, it may be hogged off and used to supplement the corn ration. In parts of the United States it is a common practice to seed soybeans and corn together for pasturing both hogs and sheep.

The use of the soybean alone for ensilage is not recommended but high quality ensilage has been produced by a combination of soybeans and corn mixed in the proportion of about one part soybeans to three parts corn. The two crops can be grown together or they may be produced separately and mixed at the time of filling the silo. Harvesting will be easier and the mixture better obtained where the two crops are grown separately.

The soybean is sometimes used to advantage by cutting and feeding in the green state. Similar to alfalfa and red clover the green forage is high in protein. Being fairly resistant to drought the crop may prove extremely valuable in overcoming pasture shortage which frequently occurs in mid-summer and later in the season.

The soybean crop may be used very effectively for soil improvement. For this purpose it is important that the plants shall be plentifully supplied with root nodules, as the result of proper inoculation, and that the crop shall be ploughed

down not later than the flowering stage. Simply ploughing down the roots and stubble after the crop has been cut and removed as hay will not increase the nitrogen supply of the soil. It is necessary that the entire crop shall be turned under. Marked improvement in grain crops following soybeans, however, is frequently observable even when the crop has been harvested for hay or seed, a result which is due mainly to the greater availability of nitrogen previously stored by the soybean roots and also the improved physical condition of the soil. This is particularly true after crops of soybeans which have been grown in cultivated rows.

Varieties

Soybean varieties are very numerous. They include many types and cover a wide range in maturity. In Manchuria, the home of the soybean, practically every district is said to have its own particular variety or strain. In the United States, it is reported that over 7000 seed selections have been obtained and planted for study. In Canada hundreds of samples of seed have been secured from various sources but only a comparatively few of those tested have been found suitable for growing in this country.

Based upon results of tests conducted by the Dominion Experimental Farms Branch the following varieties are considered the best of those available at present for production in Canada.

Variety	Maturity	Colour of seed
Manitoba Brown	Very early	Brown
Wisconsin Black	Early	Black
Mandarin (Ottawa)	Medium early	Yellow
Manchu (Hudson)	Medium late	Yellow (black hilum)
O.A.C. No. 211	Medium late	Yellow
Manchu	Late	Yellow (black hilum)
A.K. (Harrow)	Very late	Yellow (brown hilum)

Manitoba Brown is a semi-dwarf variety. Harvesting of the seed is difficult due to its short growth. It is essentially a seed type. Wisconsin Black grows considerably taller than Manitoba Brown and may be used for hay or seed. Mandarin is a seed rather than hay type although it can be used for hay. Manchu (Hudson) is a tall growing variety suitable for either hay or

A. K. variety being harvested for hay at the Dominion Experimental Station, Harrow, Ontario, 1933.

seed. O.A.C. No. 211 produces a medium tall growth. It is a good dual purpose variety, adapted for both hay and seed production. Manchu and A.K. are both tall growing varieties suitable for either hay or seed production.

YIELD.—In general, the yields of soybean varieties vary according to maturity, the later the variety the higher the yield. Tables 1 to 5 present the yields of seed and hay of the varieties listed above, as obtained in tests at Ottawa, Ont., Harrow, Ont., Brandon, Man., Nappan, N.S., Fredericton, N.B., Lennoxville, Que., and Charlottetown, P.E.I.

The season of 1933 at Harrow, Ont., being unusually hot and dry, had an adverse influence upon the yields of seed of the late maturing varieties. This is evident from the results in Table 2. A better and more accurate estimate of the relative yielding ability of these varieties is obtained from the data in Table 1, which gives their average performance during a period of eight years.

TABLE 1.—SOYBEAN SEED PRODUCTION

Variety	Ottawa, Ont.[1]			Harrow, Ont.[2]		
	Date of harvest	Height	Bushels per acre	Date of harvest	Height	Bushels per acre
		in.	12% moisture		in.	12% moisture
Manitoba Brown	Sept. 2	25	20·97	.....	.....	.....
Wisconsin Black	" 14	31	25·35	.....	.....	.....
Mandarin (Ottawa)	" 22	30	30·36	Sept. 5	27	30·10
O.A.C. No. 211	.....	.....	.....	" 18	31	33·16
Manchu	.....	.....	.....	" 25	37	35·99
A.K. (Harrow)	.....	.....	.....	" 28	41	37·41

[1]Averages, 5 years, 1929 to 1933. Average date of seeding, May 20.
[2]Averages, 8 years, 1925 to 1932. Average date of seeding, May 20.

TABLE 2.—SOYBEAN SEED PRODUCTION, 1933

Variety	Ottawa, Ont.[1]			Harrow, Ont.[2]		
	Date of harvest	Height	Bushels per acre	Date of harvest	Height	Bushels per acre
		in.	12% moisture		in.	12% moisture
Manitoba Brown	Sept. 2	25	23·05	.....	.....	.....
Wisconsin Black	" 17	33	30·42	.....	.....	.....
Mandarin (Ottawa)	" 21	34	35·68	Sept. 3	26	30·70
Manchu (Hudson)	" 29	41	36·29	" 9	35	31·34
O.A.C. No. 211	Oct. 1	36	35·92	" 10	30	29·70
Manchu	.....	.....	.....	" 22	36	27·27
A.K. (Harrow)	.....	.....	.....	" 25	42	25·66

[1]Date of seeding, May 23.
[2]Date of seeding, May 24.

TABLE 3.—SOYBEAN HAY PRODUCTION

Variety	Ottawa, Ont.[1]				Harrow, Ont.[2]			
	Date of cutting	Height	Tons per acre		Date of cutting	Height	Tons per acre	
			Green	Hay			Green	Hay
		in.		15% moisture		in.		15% moisture
Manitoba Brown	Aug. 15	20	5·80	1·71	.....	.....	.....	.....
Wisconsin Black	" 19	26	8·36	2·27	.....	.....	.....	.....
Mandarin (Ottawa)	" 21	27	11·06	3·21	Aug. 17	27	8·45	2·83
O.A.C. No. 211	.....	.....	.....	.....	" 24	31	8·84	2·92
Manchu	.....	.....	.....	.....	" 28	36	9·19	3·06
A.K. (Harrow)	.....	.....	.....	.....	Sept. 4	42	10·41	3·41

[1] 1932. Row seeding. Date of seeding, May 19.
[2] Averages, 4 years 1929 to 1932. Drill seeding. Average date of seeding May 20.

TABLE 4.—SOYBEAN HAY AND SEED PRODUCTION

BRANDON, MAN.—1932[1]

Variety	Hay			Seed		
	Date of cutting	Yield per acre	4-year Average	Date of harvest	Yield per acre	4-year average
		tons	tons		bush.	bush.
Manitoba Brown	Aug. 16	2·30	1·80	Sept. 9	11·83	11·96
Wisconsin Black	" 23	3·08	2·42	" 12	16·80	14·14

[1] Date of seeding, May 12. Seeded in rows 3 feet apart.

BRANDON, MAN.—1933[1]

Variety	Hay			Seed		
	Date of cutting	Height	Yield per acre	Date of harvest	Yield per acre	Maturity
		in.	tons		bush.	per cent
Wisconsin Black	Aug. 29	23	3·27	Sept. 14	25·9	100
Mandarin (Ottawa)	" 29	25	3·66	" 14	33·7	90
Manchu (Hudson)	" 29	34	3·56	" 25	24·6	75
O.A.C. No. 211	" 29	31	3·64	" 25	24·0	50
Manchu	" 29	37	3·45	Too immature to harvest		

[1] Date of seeding, May 10. Drill seeding.

VARIETAL ADAPTATION.—The adaptation of soybean varieties to the various parts of the Dominion is indicated to some extent in the data contained in Tables 1 to 5. In Quebec and the Maritime Provinces, Mandarin can be depended upon to mature only in those sections most favoured with regard to both soil and season. Manitoba Brown and Wisconsin Black might prove suitable in districts with less favoured conditions. In Ontario, Mandarin, O.A.C. No. 211, Manchu and A.K. are being grown at present. Mandarin matures regularly at Ottawa and is therefore adapted for production over a fairly wide portion of Eastern Ontario. O.A.C. No. 211 is suitable for seed production in central and western Ontario generally, while A.K. is limited in adaptation to the extreme southwest portion of the province. Manchu can be used where a variety intermediate in maturity between O.A.C. No. 211 and A.K. is desired.

While Manchu (Hudson) appears to be somewhat earlier than O.A.C. No. 211 it nevertheless has much the same adaptation for seed purposes. The Prairie Provinces are limited almost entirely to the early maturing varieties, Manitoba Brown and Wisconsin Black. Manitoba Brown, being considerably earlier, has much the wider adaptation of the two, but where conditions warrant the use of a somewhat later variety, Wisconsin Black can be used. Mandarin has been grown to maturity in southern Manitoba (see Table 4) but only under very favourable conditions can it be depended upon to produce seed. In British Columbia both Mandarin and O.A.C. No. 211 have been matured and it is probable that these varieties may be adapted for seed purposes to certain favoured sections of the Province. At the Dominion Experimental Farm, Agassiz, B.C., the following varieties; Mandarin, Manchu (Hudson), O.A.C. No. 211 and Manchu (Disco), were tested for hay and the same varieties with the addition of several others were tested for seed. Regarding the hay test the

Increase field of Madarin at maturity, grown at the Central Experimental Farm, Ottawa, Ontario, 1933.

following observations were made; that while the varieties, especially Mandarin gave some evidence of promise, the results as a whole were far from encouraging and the possibility of success in growing soybeans for hay in the Fraser Valley is very questionable, owing to the unfavourable weather conditions which frequently prevail at the time of harvest. In the seed test Mandarin again gave the most favourable results, but although a fair yield of seed was obtained from several varieties the harvesting presented serious difficulties because of heavy fall rains. It was concluded, that weather conditions in the Fraser Valley during the fall are generally speaking not ideal for the harvesting of soybean seed to best advantage.

Protein and Oil.—The percentage protein and oil content of soybean seed tends to vary inversely—the higher the protein the lower the oil and vice versa. Under the same conditions certain varieties are consistently high protein producers while others are uniformly high in oil production. The majority, however, approximate the average in the percentage of protein and oil.

The protein and oil content of seed produced in various parts of the Dominion is presented in Table 6.

TABLE 5.—SOYBEAN HAY AND SEED PRODUCTION, 1933

Variety	Nappan, N.S.					Fredericton, N.B.			Lennoxville, Que.			Charlottetown, P.E.I.		
	Hay		Seed			Seed			Hay			Seed		
	Date cut	Tons per acre	Date harvested	Average height	Yield per acre	Date harvested	Average height	Yield per acre	Date cut	Average height	Tons per acre	Date harvested	Average height	Yield per acre
		15% moisture		in.	bush.		in.	bush.		in.	15 % moisture		in.	bush.
Manitoba Brown	.....	.....	Sept. 25	13·0	17·9	Sept. 21	29	29·3	Sept. 7	33	3·54	Oct. 31	18	19·2
Wisconsin Black	.....	.....	Oct. 1	15·0	22·8	" 29	29	27·9	" 7	34	3·37	" 31	19	21·8
Mandarin (Ottawa)	Sept. 23	2·76	" 21	20·5	27·5	Oct. 12	32	29·8	" 7	36	3·57	" 31	24	20·2
Manchu (Hudson)	" 23	2·81	" 21	23·0	24·8	" 12	39	24·8	" 7	39	3·64	" 31	28	23·5
O.A.C. No. 211	" 7	3·36	" 21	23·5	28·7	" 12	34	27·0	.....	.....	.....	" 31	26	24·7
Manchu	" 7	3·57	" 26	27·5	18·1	" 12	42	12·8	.....	.....	.....	" 31	28	.....

Date of Seeding; Nappan, May 25; Fredericton, May 26; Lennoxville, June 3; Charlottetown, June 6. Maturity of Seed; Fredericton and Charlottetown—Manitoba Brown and Wisconsin Black—ripe; Mandarin—fairly mature; other varieties—immature.

TABLE 6.—PROTEIN AND OIL CONTENT OF SOYBEAN SEED[1]

Variety	Ottawa, Ont.[2] 12% moisture		Harrow, Ont.[3] 12% moisture		Brandon, Man.[5] 12% moisture		Calgary, Alta.[5] 12% moisture		Avonport, N.S.[5] 12% moisture		Sidney, B.C.[5] 12% moisture	
	Protein	Oil	Protein	Oil	Protein	Oil	Protein	Oil	Protein	Oil	Protein	Oil
Manitoba Brown	35·46	15·87	39·72[4]	15·36[4]	38·65	15·28	36·67	13·21	.....	.....	32·48	15·58
Wisconsin Black	33·11	17·46	38·61[4]	16·89[4]	39·35	16·02	39·05	14·11	.....	.....	.....	.....
Mandarin (Ottawa)	34·92	17·29	39·98	16·34	.....	.....	.....	.....	30·88	16·24	.....	.....
O.A.C. No. 211	.....	.....	39·12	15·94	.....	.....	.....	.....	.....	.....	.....	.....
Manchu	.....	.....	37·22	17·05	.....	.....	.....	.....	.....	.....	.....	.....
A.K. (Harrow)	.....	.....	36·52	17·26	.....	.....	.....	.....	.....	.....	.....	.....

[1] Analyses made by the Division of Chemistry, Central Experimental Farm, Ottawa, Ont. [2] Averages, 4 years 1929 to 1932. [3] Averages, 5 years 1928 to 1932
[4] Averages, 3 years, 1930 to 1932. [5] 1932 only.

It would appear that environmental factors have a definite effect upon the composition of soybean seed. Climatic factors, especially rainfall, appear to exert the greatest influence. There is some indication that low rainfall may favour the formation of protein and that higher rainfall may tend to reduce the protein content. Analyses given in table 6 show that seed grown at Calgary, Alta., Brandon, Man., and Harrow, Ont., which are located in areas of relatively low rainfall, contain appreciably more protein and slightly less oil than seed grown at Sidney, B.C., Ottawa, Ont., and Avonport, N.S., which are more favourably situated with respect to moisture.

Size of Seed.—Size of seed is of some importance in seeding. Following is the average weight in grams of 1,000 seeds. The weights were obtained from seed grown at Harrow, Ont., during a period of several years:—

Manitoba Brown	199
Wisconsin Black	165
Mandarin	205
O.A.C. No. 211	225
Manchu	185
A.K.	162

Reference to Tables 1 and 2 shows that size of seed is not related to either yield or maturity.

Colour of Seed.—Soybean seed colour is important only from the standpoint of commercial utilization, yellow seed being preferred to either brown or black.

Registration.—The following varieties are eligible for registration by the Canadian Seed Growers Association:—Manitoba Brown, Mandarin (Ottawa), O.A.C. No. 211 and A.K. (Harrow).

Culture

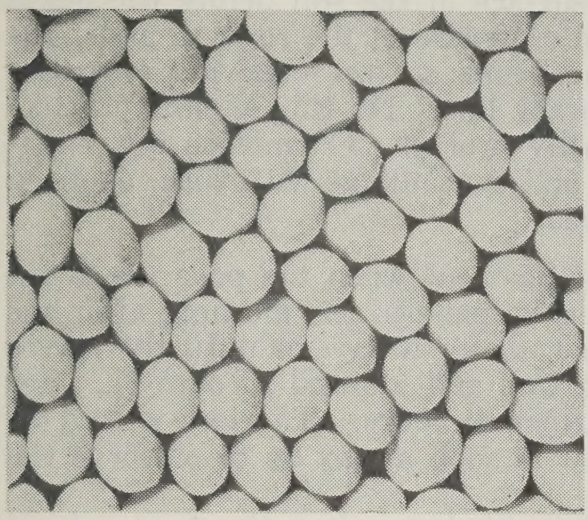
Soil Preparation.—Essentially the same as for corn. Fall ploughing preferably, followed by a thorough working in the spring to provide a fine, smooth seed bed. Proper spring preparation will help materially in overcoming the weed menace later in the season.

Time of Seeding.—About the middle of May—a little earlier or a little later depending upon the locality and the season.

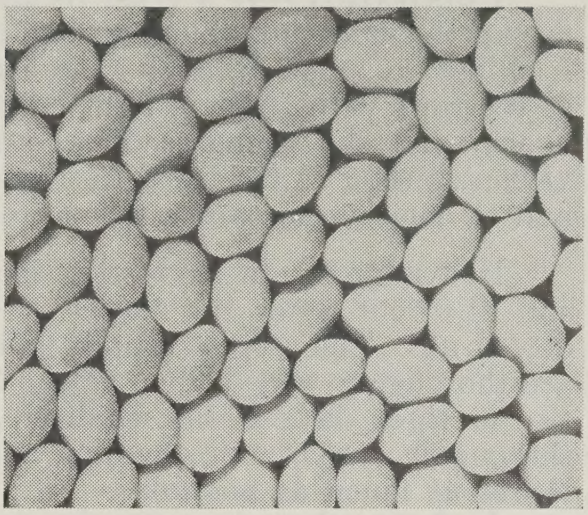
Inoculation of Seed.—For best results this is important where the crop is being grown in a field for the first time. Sufficient culture for one bushel of seed, with directions for making the inoculation, can be obtained free of charge from the Division of Bacteriology, Central Experimental Farm, Ottawa, Ont.

Method of Seeding.—Seeding may be done either in rows 28 to 30 inches apart or in 6-inch drills, similar to wheat or oats. For seed production the row planting is best. The rows may be spaced closer than the distance mentioned but should be sufficiently wide to permit of machine cultivation. Drilling solid is generally recommended for hay production. It produces hay with finer stems and if anything, slightly higher yields than row planting. Under no conditions, however, should this method of seeding be used if the land is known to be weedy. Soybeans grow very slowly at first and heavy weed growth may ruin the crop entirely. Row seeding will require about 30 to 40 pounds of seed per acre, while drilling solid for hay requires about one and one-half to two bushels of seed per acre (one bushel = 60 pounds).

Depth of Seeding.—This depends upon the type and condition of the soil. One to two inches is usually satisfactory.

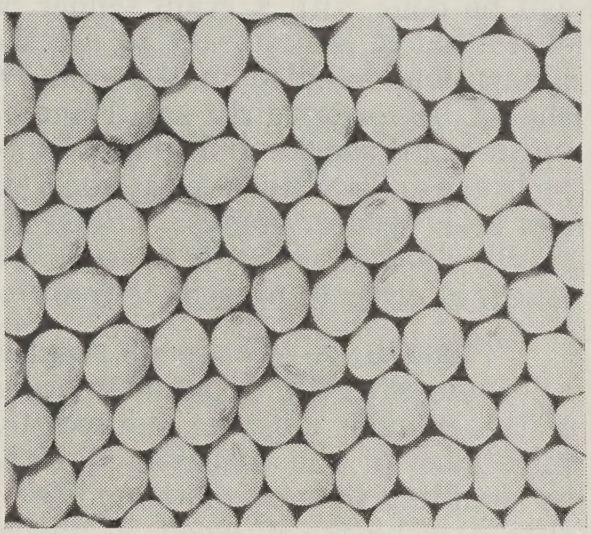


Mandarin
(Yellow)

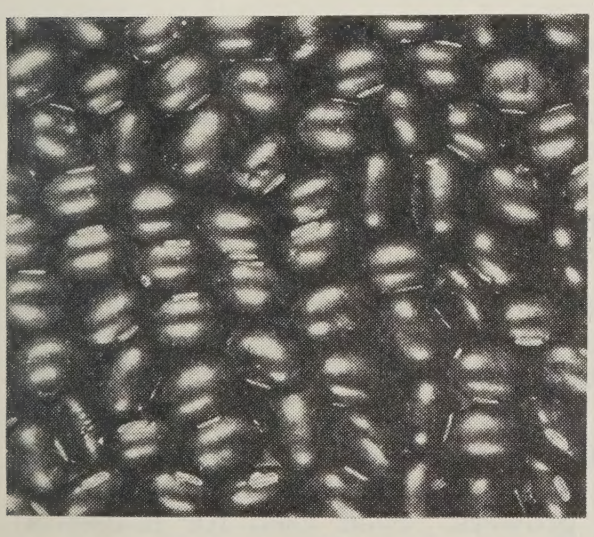


O.A.C. No. 211
(Yellow)

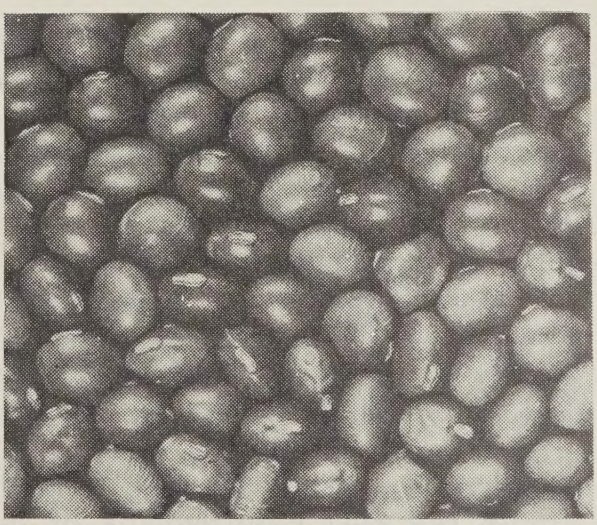
Manchu
(Yellow-black hilum)



A.K.
(Yellow-light brown hilum)



Wisconsin Black
(Black)



Manitoba Brown
(Brown)

Seed of the six soybean varieties mentioned in this bulletin.

CULTIVATION.—If a crust forms at the surface of the soil before the beans are up the smoothing harrow should be used crosswise of the rows to assist the seedlings to break through. As soon as the beans are up, cultivate crosswise of the rows with either a light harrow or rotary hoe. Do this on sunny afternoons when the young seedlings are not easily broken. Commence row cultivation as soon as the rows are readily seen and continue as with corn, as often and as long as necessary to control the weeds.

HARVESTING.—In harvesting the crop for hay, cut when the pods are about half filled out, using the mower. This should be done in the morning after the dew if off. The crop is usually left in the swath for a day, or until the leaves are thoroughly wilted, then raked into windrows and allowed to cure or, after two or three days in the windrows, put into small cocks. The hay should be thoroughly cured before hauling and handled in such a way as to preserve the leaves as much as possible.

In harvesting the crop for seed, cutting is done after the leaves have dropped off. Practically all varieties of soybeans lose their leaves at maturity. At this stage the pods will be brown and dry. If the pods shatter badly it is advisable to cut in the morning when they are damp with dew. Harvesting can be done with a grain binder or a self rake reaper. Unless the crop is so short that it is necessary to use the mower, soybeans are usually cut with the binder and handled in the same way as ordinary grain crops. The bundles should be made fairly small and not bound too tightly. They may be set up in small shocks and allowed to cure or may be threshed immediately if the pods are dry and the seed is good and ripe. After curing in the shocks soybeans can be housed or stacked. Since the mature soybean plants do not shed water readily themselves, it is necessary to use straw or other material to cover the stack, in order to prevent it from becoming water soaked.

THRESHING.—The grain separator may be used to thresh the crop provided a few adjustments are made in order to prevent splitting of the seed. The speed of the cylinder must be reduced by about one-half, while the speed of the remainder of the machine must be maintained. This may be accomplished by doubling the size of the cylinder pulleys. It may also be necessary to substitute a block of wood in place of the concaves. Soybeans can also be threshed with an ordinary bean thresher.

Storage and Marketing

Careful handling of soybeans immediately after threshing is essential. Seed containing more than 12 to 14 per cent of moisture should not be stored in a deep bin but should be spread out so that it can be easily turned if heating occurs. It might even be advisable, if the quantity is not too large, to put the seed in sacks which can be moved from time to time to allow free circulation of the air. Improper storage may easily result in heating and moulding and impaired germination of the seed.

Marketing soybean seed is not complicated. The beans are used for three main purposes—for feed, for seed and industrial uses. Very little if any soybean seed is marketed for feed, and if used for this purpose it is usually fed at the farm on which it originates. Of the beans sold for seed, probably the greatest proportion is marketed directly by the growers themselves. Some seed is disposed of through the regular seed-houses, while the oil mills may arrange to supply the seed requirements of intending growers. Seed used for industrial purposes is at present marketed directly by the farmers. There are at present two oil mills crushing soybean seed in Canada (both located in Ontario) and the seed requirements of both are produced almost entirely under contract.

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